# Multi-mode diode tester

**I have a plastic container half-filled with mixed diodes on my workbench. Many are umarked but cover the range of signal and power types, Zeners, LEDs and even varactors (variable capacitance diodes). I recently decided it was time to sort these out so that I can use them in various projects.**

PHOTO 1: General view of the completed diode tester.

## Tester required

I needed a simple tester that could do all the necessary tests in one low-cost, easy-to-build box or the job of sorting my diodes would be too tedious to even start. I came up with a really useful diode tester you can make for yourself for well under £20. **Figure 1** shows the circuit diagram and the finished device is shown in **Photo 1**.

It's powered by a PP3 battery. The current demand is low, so the battery will have a long life. The circuit is based on a NE555 oscillator driving fast pulses via Q1 into L1, thus forming a simple switch-mode inverter with D1 and C3.

Those who are familiar with the NE555 may wonder at the way it's wired up. The conventional oscillator circuit, shown in **Figure 2**, uses a resistor (R2 in Figure 2) from open collector output pin 7 to the Threshold and Trigger pins 6 and 2. However, I found that if I connected the resistor to the sink *and source*-capable output on pin 3 – which has the same logic state as pin 7 – I could get much narrower pulses, which are more suitable for driving the BD139 switching transistor.

These high frequency, short pulses briefly turn on Q1, producing a very spiky, high voltage pulse at its collector due to the current flow and collapse in L1. This high voltage is rectified by D1 and smoothed by C3 to around 75V. This is fed via current limiting resistor R3 to a shunt regulator chain formed by the three 20V Zener diodes ZD1, ZD2 and ZD3. Switch SW1b is arranged to take the anodes of either ZD2 or ZD3 to ground, thus changing the voltage limit from 60V to 40V or 20V. The final voltage is fed to the digital voltmeter (DVM) module and also to the test terminals at SKT1. SW3 is configured as a changeover switch to swap the polarity of the output, very convenient for checking forward and reverse voltages.

The output impedance is high, limited to a maximum of about 7mA regardless of settings. At this current, the output will drop below 1V. It will rise to the correct voltages

PHOTO 2: Inside the device (battery not shown).

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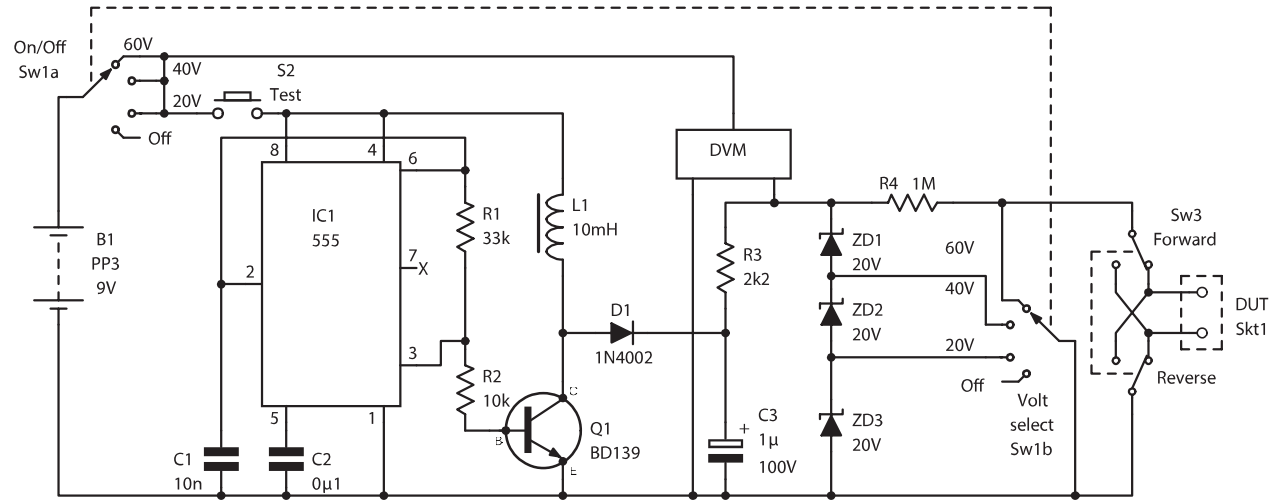


FIGURE 1: Full circuit diagram of the diode tester.

PHOTO 3: Typical test showing the 3.1V forward voltage of a blue LED.

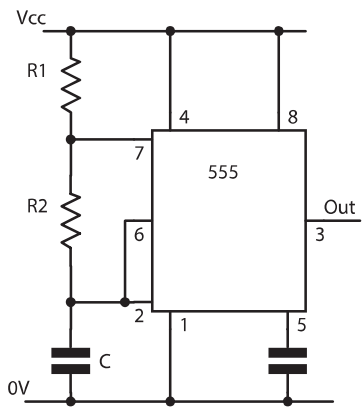


FIGURE 2: The 'classic' NE555 circuit.

as the current reduces to 2mA or less. This is sufficient to illuminate even low brightness LEDs, but too limited to over-drive an LED or to damage it in reverse test mode. So, when making tests you don't need any ballast resistors to protect your LEDs and Zeners – the tester takes care of that for you. And the tester will help you determine what sort of diode you have and its polarity, even if it's completely unmarked.

## Construction

Construction is very straightforward. There are no particular layout requirements. I built my prototype on stripboard, mounting the switches and DVM onto the front panel of the enclosure. The plastic box I used was 60 x 80 x 120mm that cost me about £3.50. My suggested stripboard layout is shown in **Figure 3**, whilst **Figure 4** shows the general wiring diagram. **Photo 2** gives a general guide to how I wired up my prototype. I built everything onto the front panel except the battery, which is mounted in the case itself. This makes for much easier building and service.

## *Mode d'emploi*

In use, the DVM is illuminated as soon as the tester is switched on. It should read 0V because the inverter circuit isn't yet energised.

Set the voltage to 20V and place a diode between the two terminals. It doesn't matter which way round. In Forward mode, the red test socket is positive, but you never have to physically reverse the diode under test thanks to the Forward/Reverse switch, S3. Press S2 to run the oscillator and note the voltage reading. Then reverse the voltage by switching S3 and note the voltage again.

Silicon signal and power diodes should read about 0.7V in one direction and 20V (or 40V or 60V) in the other direction, ie they are not conducting. A specific voltage

reading such as 12V indicates a Zener. If you suspect that the device is a Zener of higher than 20V you can increase the test voltage to 40 or 60V using the rotary switch. Although there exist Zeners of (considerably) above 60V, I suspect they are relatively rare in most people's junkboxes.

Germanium diodes will read about 0.2-0.3V in the forward direction. Be aware that some germanium diodes have only a fairly low reverse voltage rating (the OA47 was only rated at 25V) so don't automatically assume you can test everything at 60V.

If the diode is an LED, it will be illuminated when testing in the forward direction (anode to the red terminal) and extinguished in reverse. The forward voltage is displayed (approximately 2V for red, green and yellow types, around 3V for blue and up to 4V for white). LEDs generally have very low allowable reverse voltage *ratings* – perhaps as low as 5V – but my experience is that I have never damaged a LED by applying up to 20V reverse voltage. (If you're expecting to test a lot of LEDs it may make sense to reconsider the voltage ratings of ZD1 to ZD3 so you can have, say, 5.1V, 24V and 60V ranges).

Note that although the test current is relatively small, 7mA maximum, this may exceed the forward current rating of a small number of special purpose diodes.

Finally, don't forget that you have to press the test button each time to do a test. No voltage will appear at the test terminals until then. This arrangement ensures a long battery life, since the only significant current draw occurs while the oscillator is actually running, other than that required by the DVM.

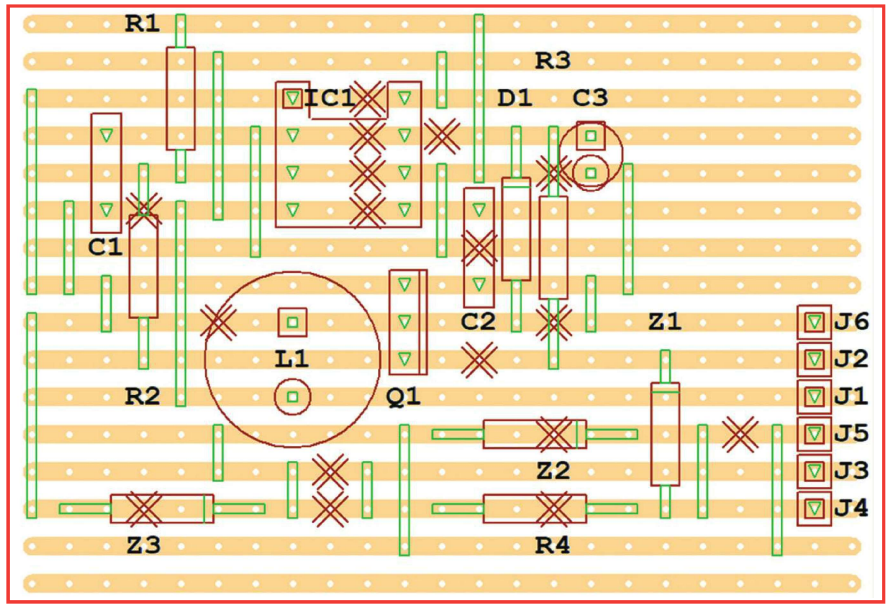


FIGURE 3: Suggested stripboard layout, from the component side. A 'double X' indicates a track break.

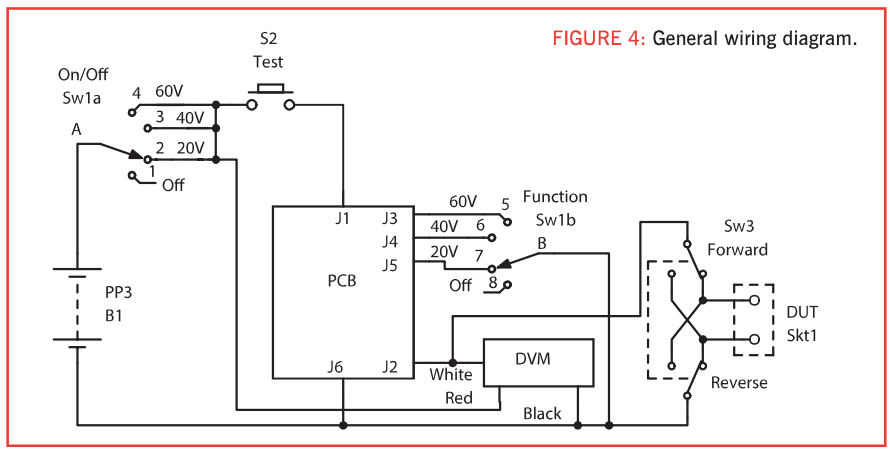


FIGURE 4: General wiring diagram.

## Component availability

All the components are fairly inexpensive and readily available via eBay, the usual component distributors, or even at rallies. The only mildly unusual item is the 100V DVM, a small, panel mounted all-in-one digital voltmeter, but these are available as snap-in modules on eBay and elsewhere for a pound or so. The photos should give you a guide. Make sure you get a three-wire version (supply, ground, input) rather than the 2-wire versions that have a limited measuring range, typically 3-30V.

SW1 was a 4-way 3-pole unit (only two poles are used), which was under £1. You could choose to use a 6-way 2-pole switch to give a wider range of voltages, as hinted earlier – perhaps, with suitable Zeners, 5.1V, 12V, 24V, 40V, 60V.

The 10mH choke and 20V Zeners were bought in packs of 10, again for low cost. Everything else in the circuit should be even easier to obtain.

PHOTO 4: Testing a 5.3V Zener diode.